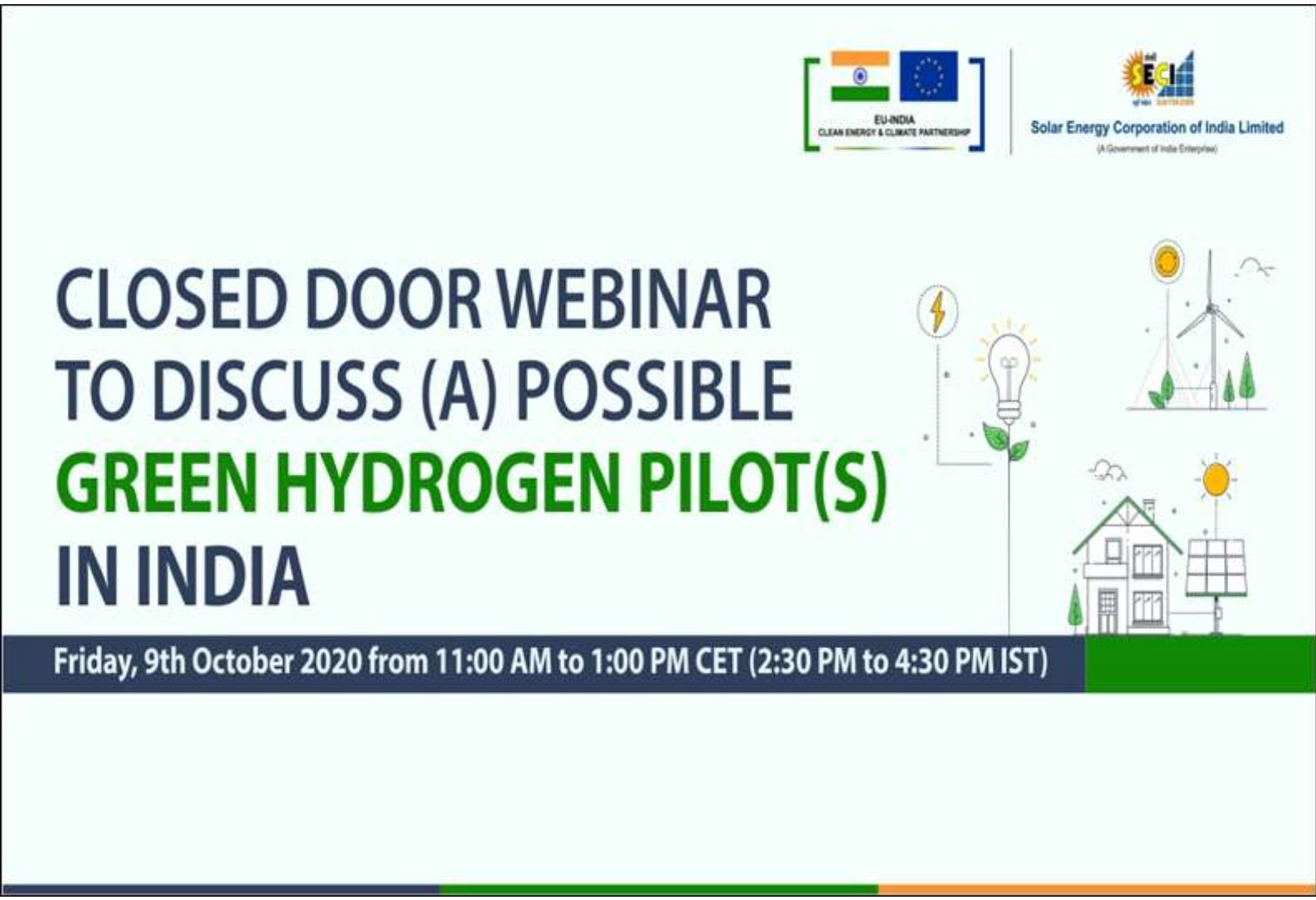

Webinar Proceedings

Close door webinar to discuss (a) possible green hydrogen pilot (s) in India

On 9th October 2020, the Delegation of the European Union to India in cooperation with the Directorate-General Energy, European Commission and the Solar Energy Corporation of India (SECI) organized a close door webinar 'to discuss (a) possible green hydrogen pilot(s) in India.' The webinar was supported by the EU-India Clean Energy and Climate Partnership (CECP) project (Website: www.cecp-eu.in and Twitter-@EU_India_CECP) and was attended by more than 75 participants, representing policymakers, regulators, project developers, technology solution providers, manufacturers, energy performance contractors, think thanks, consultants and academia.

1.1. Inaugural Session

Mr. Joel Fernandes, Project Lead Europe, Business Support to EU (India Policy Dialogues) welcomed the participants and presented the agenda and the broad objectives of the webinar. He emphasized the importance of today's discussion as a bridge to initiate a dialogue between SECI and EU Hydrogen sector players, hopefully resulting in cooperation on (a) green hydrogen pilot project(s) in India.

Mr. Edwin Koekkoek, Counsellor, Energy and Climate Action, Delegation of the EU to India introduced the EU-India CECP partnership (www.cecp-eu.in), which was agreed at the highest level at the EU-India Summit in 2016. He set out how the recently published EU-Hydrogen strategy, is considered a key priority in realizing EU's clean energy transition towards climate neutral Europe by 2050[1].

Sh. Jatindra Nath Swain, Chairman and Managing Director, Solar Energy Corporation of India Ltd. (SECI) discussed SECI's overall role in the RE demand aggregation, acting as intermediary between procurers and seller and importantly, acting as a market maker for the application of renewable energy in India. He highlighted SECI's overall portfolio of 36 GW (26 GW solar+ 10 GW wind and solar-wind hybrid) and its ambitious targets of achieving 10 GW solar and 5 GW wind on a yearly basis in the future. He emphasized that SECI is looking for opportunities beyond supplying power to the grid. In this regard 'production of green hydrogen' is deemed an important technology solution for SECI, having a number of applications in the chemical industry (fertilizers), oil refining, steel making, transportation and enrichment of natural gas. India is the world largest consumer of Urea and second largest producer of steel. Hence, there is anticipated demand of green hydrogen.

He then talked about the possible contribution to reducing carbon emissions and the dependency on natural gas, by allowing the country to have a higher penetration of RE. SECI strives to offer counter party guarantee, a stable market for hydrogen and to facilitate investment. It would be welcoming if EU stakeholders would invest in green hydrogen production and supply, and at the same time collaborate with SECI on developing cost-efficient hydrogen production technologies.

Sh. Amitesh Kumar Sinha, Joint Secretary, Ministry of New and Renewable Energy (MNRE) set out the key developments in the Indian market: the RE target of 175 GW by 2022, 450 GW by 2030 and the overall progress made (89 GW realized, 43 GW under implementation and 28 GW under tendering). He referred to the Ministry's innovative stance with respect to recent tendering involving RTC, Peak Power and expressed his interest to conduct similar bids for hydrogen as well, depending on the viability of the technology as a storage option. He discussed a few critical applications of hydrogen in India's overall energy planning:

[1] https://op.europa.eu/en/publication-detail/-/publication/92f6d5bc-76bc-11e9-9f05-01aa75ed71a1

- Role of hydrogen fuel cells in grid stability (allowing for shifting of power), especially going forward as large amount of RE gets injected into the grid;
- Replacing fossil fuels in Industrial applications such as steel and fertilizer industry;
- Transportation, particularly in case of larger vehicles.

Cost effectiveness is a critical parameter for integrating hydrogen in all processes, considering it will compete directly with battery storage technology solutions. The cost of RE around the globe is reducing substantially and this will assist in bringing down costs for hydrogen, apart from the technological advancements in equipment costs. He estimated that for hydrogen to become viable for implementation, the cost of power needs to comes down to 1$ per unit.

Dr. P. C. Maithani, Scientist G, Ministry of New and Renewable Energy (MNRE), lauded the EU-hydrogen strategy which came on 8th July 2020, setting ambitious targets of achieving 13-14% of energy demand from hydrogen by 2050. He talked about the history of EU-India collaboration in hydrogen and the National Hydrogen Board which was established in 2005[2]. He highlighted 4 critical areas to address, to allow for hydrogen as major energy carrier:

- Cost-competitiveness of hydrogen as a technology option;
- Cost competitive conversion technologies and standardization of technologies for conversion into end-use applications;
- Storage technology;
- Applications and initial focus (beyond transport).

He referred to the concentrated efforts required for generating higher volumes. With relevant policies and regulations in place, mainstreaming can be achieved in 6-8 years. He mentioned the long-term hydrogen roadmap that India is planning to develop over the next few months, involving the following 4 key thematic areas:

- Niche applications which can be taken up on a short-term basis;
- Necessary policy and regulatory instruments for undertaking demonstration and large-scale projects;
- R&D priorities;
- International cooperation.

The cooperation with the EU provides a very good opportunity for leapfrogging from existing knowledge and experiences in hydrogen field, to ascertaining actual requirement on the project implementation front. He also articulated the need to collaborate at institutional and academia level and undertake application-oriented research work pertaining to local prevailing conditions to get necessary value add over shorter time period.

1.2. Introduction on EU hydrogen strategy

Mr. Tudor Constantinescu, Principal Advisor, DG Energy, European Commission, referred to the recent EU-India summit and stressed the importance of furthering the cooperation on clean energy with India. The European Green Deal[3] is considered an important tool for fostering economic development and ensuring sustainable investment. The European Commission has proposed the ambitious targets of 55% carbon

[2] http://164.100.94.214/sites/default/files/uploads/abridged-nherm.pdf
[3] https://ec.europa.eu/commission/presscorner/detail/en/ip_20_940

reduction and 65% electricity generation through renewables by 2030. This causes a challenge of integrating such large share of renewable energy into the grid.

He mentioned the possibility for renewable fuels such as biomethane, biogas, and also hydrogen as an enabler for synthetic gases and synthetic fuel. Hydrogen can in particular play a role in large scale storage, including for grid balancing and decarbonizing energy intensive sectors.

He set out the EU hydrogen strategy[4], and the ambitious target of 40 GW electrolyzers by 2030. The strategy focusses on scaling up hydrogen (with a special focus on renewable hydrogen, along with other low carbon hydrogen options) adoption in sectors where it makes economic sense, such as heavy-duty transport, fertilizer and ammonia production. He referred to the launch of a 100 MW electrolyser project under the EU-Green deal, assisting in hydrogen collection in industrial clusters in the coastal areas and to bring the benefit to other Key facets with regards to the further hydrogen integration are:

- Continuous research and innovation in the sector;
- Development of a concrete regulatory framework;
- A hydrogen certification programme.

He addressed the bilateral and multilateral cooperation with India, including in the G20 and under Mission Innovation. He would be keen on further cooperation in the hydrogen sector as well.

Mr. Ruud Kempener, Policy Officer, DG Energy, European Commission, highlighted the following key policy measures:

- Supply side support instruments: introducing support schemes creating supply for renewable hydrogen, specially given the fact that it is still not cost-competitive compared to fossil-based hydrogen;
- Demand side options: Specific targets or quotas in sectors where hydrogen is already being used or in applications where the use of hydrogen has the biggest added value, such as industry processes, heavy duty transport over long distances;
- Developing a renewable hydrogen framework, as there are many different pathways to produce hydrogen, including transformation technologies and transportation solutions, with different associated GHG emissions;
- Creating a common terminology for RE hydrogen and other gases available and possible certification, both in terms of production and the kind of emissions during the whole lifecycle of the different hydrogen options.

As far as the 40 GW electrolyzer target by 2030 is concerned, 6 EU member countries have already drafted hydrogen strategies, aggregating to 22-26 GW. The target is thus considered to be realistic. It would be interesting to work together with other countries, in particular in the following areas:

- A common certification scheme and framework?
- Identification on areas where the added value of renewable hydrogen production is the highest?
- The cost-effective use of hydrogen to allow a transition to a renewable energy based energy system

[4] https://ec.europa.eu/energy/sites/ener/files/hydrogen_strategy.pdf

1.3. Introduction to the proposal for setting up a hydrogen pilot

Mr. A.K Sinha, AGM (Schemes), SECI gave a presentation about the overall prospect of setting up a green hydrogen pilot in India. The key aspects covered by him included the following:

- India's RE sector and the strategy for promotion of RE;
- Role of SECI as a facilitator and bankability of PPA (well-established proven system, never defaulted);
- Why Green Hydrogen: advantages in making solar and wind predictable, storage, as another RE source and ease of scalability;
- Proposal for the pilot: SECI considers to install a 2000 ton per annum green hydrogen plant near a fertilizer industry in India, in which it will act as the nodal agency between the renewable energy supplier, H2 production unit and the fertilizer industry, ensuring timely payments and reducing the overall risk proposition. It is looking for partners with cutting edge technologies to supply hydrogen at a competitive price. The successful pilot may result in a nation-wide scheme and deployment at large scale.
- Likely support expected for the pilot project includes:
    - As regards the land for development of the electrolyzer and H2 storage, SECI may coordinate with the respective state government to facilitate the land availability;
    - Energy requirement: SECI may coordinate with the renewable energy producers for supply;
    - As regards the buyer: SECI may tie up with the fertilizer industry for long term sale of green hydrogen;
    - Capital and operational expenditure: the plan developer is to arrange capital and operational expenditure;
    - Technology: the developer is to provide the technology (technology agnostic)
- It would be good to share experiences and technologies with the EU as regards the technical aspects of the project implementation

Presently, SECI is actively engaging with the fertilizer industry and the Ministry as regards the design of possible support mechanisms or incentives, which can be provided to the project developers to make the technology more cost-competitive and will consider the actual proposal once the on-ground cost of implementation has been clarified.

1.4. State of art of green hydrogen research and innovation projects in the EU

Mr. Bart Biebuyck, Executive Director, Fuel Cells and Hydrogen Joint Undertaking, welcomed the existing partnerships with India, including the international partnership for hydrogen and fuel cell economy (IPHE)[5] and Mission Innovation, innovation challenge 8[6], focusing on the scaling of electrolysers from MW to GW. He showcased through numerous case studies, how with gradual project scalability the overall capex of the plant will reduce and how in 10 years a transition from 100 kW to 100 MW took place in Europe, which can be relevant for the Indian context. The industrial examples cited by him included:

[5] https://www.iphe.net/
[6] http://mission-innovation.net/our-work/innovation-challenges/renewable-and-clean-hydrogen/

- 2014-Green light industry and transport (Hybalance Project): Producing green hydrogen from wind, feeding metal industry and bus fleet;
- 2016: Greening the steel industry (H2 future project): Producing green hydrogen from hydro power, injecting in steel industry, providing grid services;
- 2016: Greening the food industry (Demo4Grid Project): Producing green hydrogen from hydro power, combustion in boiler of food industry;
- 2017: Greening the refining industry (Refhyne Project): Producing green H2 from renewables, displacing grey SMR hydrogen for grid and load balancing;
- 2015: Green steel surface treatment industry (GrlnHy Project): Green Industrial Hydrogen via Reversible High-Temp Electrolysis.

Key initiatives to mainstream hydrogen in the EU, which include:

- Certification and the initiative of developing an EU wide guarantees of origin (GO) Scheme for hydrogen;
- IPHE taskforce on Hydrogen Production Analysis methodology and the importance to unlock future cross border trading;
- Fuel cells and hydrogen observatory (launched in Se 15, 2020) to visualize one step solution where the FCH sector is and how it is evolving. (including technology, market, policies, regulations, standards, etc.).

Europe will continue to work on R&I involving H2 generation (large size, more efficient and cost effective-GW scale, mass manufacturing, new materials, low TRL), large scale end use applications (industries such as steel, chemical, Petro-chemical, transport-heavy duty road, rail, aviation, pre-normative research), infrastructure (distribute, store and dispense H2 at large volumes and distances) and cross cutting to support policy (improved and harmonized standards, social and labor market LCA, value chain, critical raw material, recycling, security of supply).

The planned initiatives to strengthen and maintain EU's global leadership in the hydrogen sector include;

- Establishing the clean hydrogen partnership, successor of FCH-JU (start foreseen 2nd half of 2021);
- Cooperation and synergies with other international partnerships in Horizon Europe and financing instruments at EU level;
- Strong international cooperation on regulation, codes and standards.

He invited to participants to attend the upcoming **First European Virtual Hydrogen Week (23-27 Nov)** focusing on research, international cooperation, investor dialogue and an important platform for sharing ideas.

Mr. David Herrero Fuentes, COO, Fertiberia, Spain, provided an in-depth perspective on the deployment of green hydrogen production in the European Fertilizer industry. He stressed the importance of ammonia in the energy transition scheme, not only as an intermediate product for fertilizer production, but also as an energy carrier of green hydrogen. He also discussed a case example of a project implemented by Iberdrola in the fertilizer industry, having a capacity of 20 MW electrolyser to be commissioned by 2021, which would be able to replace 10% of the natural gas requirement.

He provided the following key action points for the growth of hydrogen technology:

- Develop a business plan, supported by policy and support framework to operate units in a competitive manner, ensuring a level playing field;
- Provide funding for demonstration and pilot projects, especially during early stages;
- Develop standards and certifications to develop markets.

1.5. Panel Discussion

- **Mr. R. K. Malhotra**, President, Hydrogen Association of India, set out the key activities undertaken by the Association amidst the renewed the interest in last couple of years, particularly in terms of support in bringing international technologies to India. He suggested the following key measures to drive the sector forward in India:

  - Addressing challenges associated with storage capacity, storage pressures, etc. with policy development;
  - The promotion of hydrogen fuel cells, along the line of support given to EV and battery vehicles;
  - Utilizing the blue hydrogen from fossil fuels by fixation of carbon into useful chemicals to complement and exist with green hydrogen;
  - Regulatory matters involving storage, distribution and transportation of hydrogen.

  He offered to assist EU stakeholders in resolving issues pertaining to investments in India, by acting as a facilitator with Indian stakeholders.

- **Mr. Millán García-Tola**, Director Hydrogen, Iberdrola, highlighted the company's overall vision to make Spain the first country with 100% green ammonia production. He discussed in detail the 20 MW electrolyzer project with Fertiberia and the key foreseen benefits as a result of the project pertaining to grey hydrogen replacement and socio-economic impacts in terms of job creation for 2000 personnel. He further indicated that the pilot is part of a large project, in which the company is targeting to install the state of art technology with 10 MW PV bifacial panels, inverter with 5 MW Li-ion battery, to add extra capacities to maximize production of green hydrogen. A capacity of 100 MW is being targeted, capable of producing 1000 tonnes of hydrogen per annum, that will be exclusively used to produce ammonia, along with 10000 tonnes of oxygen/per annum, which will be used in Fertiberia's other industrial processes.

  On the timelines for pilot project construction in India, he indicated that the project can be implemented in 1 - 1.5 years. The most critical part is however not the construction process, but the business case to see the bigger picture and overall funding ability.

- **Mr. Florian Peter**, Project Director Djewels, McPhy illustrated through a case example the critical facets of building a 20 MW electrolyser in the north east of The Netherlands (currently in design phase), that will be the largest zero carbon hydrogen project in the EU, designed with the highest international safety standards capable of generating 3000 tonnes of Zero-Carbon H2/year, with electricity from wind. The company is building a modular electrolyzer system, using McLyzer 800 for large scale alkaline electrolysis, easily convertible to 20 MW cluster and finally into 100 MW plant, which can be easily scaled up later. He also provided insights about the product's specialty in terms of high current density, flexible and fast response time, high efficiency, high pressure (30 bar), compact footprint (20 MW installed in less than 1000 sqm) and usage of high quality standards (oil, gas and chemical combined). He also demonstrated company's vision of scaling up from 100 MW per annum to 300 MW per annum till 2023 and finally to 1300 MW per annum post 2024, through increased automation and lean manufacturing.

- **Mr. Tom Skoczyals**, Business Director, Nel Hydrogen informed about the company achievements (over 3000 electrolyzers deployed in more than 75 countries), technology offerings and specific applications for green hydrogen usage such as demonstration, fueling energy storage, off-grid housing, etc. He also expressed interest in assisting SECI with the evaluation of both alkaline and PEM technology to identify the best technology fit for Indian demographics, including possible CAPEX and OPEX requirements.

- **Mr. Gerd Deusser**, CEO Energy Business, Siemens AG discussed about the sector coupling as the key lever for the decarbonization of all end users. He referred to the ongoing projects with India, which include:

  - MoU with NTPC to develop pilots on the mobility side for an intercity bus system in Delhi and Leh, where hydrogen fuel buses are being planned;
  - Working on coal fired power plants to take the CO_2 out of the exhaust and then generate green hydrogen via solar power and bring up methanol, which can then be used as fuel;

  He also provided brief insights about 2 successfully completed projects in Europe;

  - Green Ammonia Demonstration Plant at Oxfordshire, UK (World's first roundtrip green ammonia demonstrator);
  - Green Hydrogen Demonstration Plant at France (World's first integrated power to X power hydrogen gas turbine demonstrator);

  For the upcoming Indian pilot project, he considered that looking at the proof of concept is essential and that exploring options beyond the fertilizer industry is critical. The following action points will be key for the pilot.

  - Understanding the economics of pilot, including the purpose to understand the bigger picture involving the outcomes, investor interest and partners for collaboration;
  - In terms of timelines, project can be taken up in 9-12 months' time, once agreement has been done on goals, partners and scope.

- **Ms. Giovanna Pozzi**, Head of Renewables Development & **Mr. Davide Cirelli**, Country Manager – India, Snam Italy, gave a presentation on Snam's existing portfolio in terms of pipelines, underground gas storage and import LNG terminals and additional business lines aiming at decarbonizing industrial processes such as biogas/biomethane development plants, CNG mobility, bio-CNG, blending of natural gas with low carbon type of gases, and hydrogen.

  Ms. Pozzi talked about the hydrogen opportunities across the different avenues, including:

  - Industry: Supply for green industrial processes (such as H_2 as a feedstock supply, H_2 high temperature processes systems), wherein natural gas is being heavily used today and can be replace by Hydrogen in future;
  - H_2 for grid balancing: Solutions for utilities and sector coupling (power to gas, power to power gas to power and H_2 islanded system, where over generation is captured for production of hydrogen);
  - Hydrogen for commercial use in fuel cells to produce electricity;
  - Hydrogen for transportation (economics of this sector is more interesting compared to others).

  She also briefed about Snam's successful test on its pipeline for the supply of a blending H_2NG at 10% to industrials end users. Both Ms. Pozzi and Mr. Cirelli expressed interest in engaging with Indian stakeholders, as per their convenience to share learnings and help in the pilot project development.

- **Mr. Jorgo Chatzimarkakis,** Secretary General, Hydrogen Europe, reiterated the significance of EU hydrogen strategy launched in July 2020 to produce 1 million tonnes of hydrogen by the end of FY 2024, articulating that the EU is entering a phase of 'ramping up'. To showcase this, he gave a case example of Germany, which is importing hydrogen from countries such as Morocco, Ukraine and other parts of the world to meet its high industrial process demand in the steel industry. He estimated that the carbon content of hydrogen will be the currency of commodity in the future and

India has the potential to be a net exporter of hydrogen, with several possibilities of shipping this hydrogen (liquification or in the form or as derivates like ammonia). Europe has the aspiration to become the RE hub for not only production, but also demand, in which India can play a very important role.

He emphasized that by 2040, hydrogen will act as a global commodity replacing oil, replacing coal in steel production and replacing grey hydrogen as a chemical feedstock. He lauded India's efforts to go for the fertilizer industry.

- **Mr. Patrick Clerens**, Secretary General, European Association for Storage of Energy (EASE) reflected upon the storage function of green hydrogen. He indicated this to be an essential function as the electrolyzer will not only assist in ammonia production but also provide grid services to stabilize energy systems, which is essential as large amounts of renewable energy from various sources is injected into the grid. With respect to pilot projects, he provided the following suggestions:
  - Revenue guarantee is very important for pilot projects;
  - Project funding needs to be arranged and the price economics need to work out;
  - Ideally, 1 year is optimum time for project completion.

He also provided rough estimates of the 'project CAPEX' for a project set up in Netherlands, capable of producing 3000 tonnes of methanol and 3000 tonnes of green ammonia, at a cost ranging between 600 million-1 billion euros.

1.6. Recommendations/observations from participants

- **Mr. A. K. Sinha**, AGM (Schemes) SECI stressed the importance of initiating the pilot project work as soon as possible and reinstated that the proposal is very open ended, technology agnostic and subject to further suggestions. He reassured EU technology players and project developers, that SECI will foresee the overall financial management, including assuring demand offtake for cost recovery by tying up with necessary buyers, with commitments for a long period.

- **Mr. Poul V. Jensen**, Managing Director, European Business and Technology Centre explained the importance of 'defining clusters', wherein many stakeholders from a given value chain, ideate and create projects, resulting in benefits, such as sharing of values, sharing of risks and having experts managing different parts of supply chain on a common platform. Such a 'cluster approach' provides consolidated insight to a whole value chain and not just a given component of the supply chain. The EBTC is building a hydrogen cluster within a sustainability mobility cluster. He lauded India's initial efforts and considered that pilot projects are the way to go, to learn on the ground, identify the challenges, communicate those challenges, engage with relevant people who can deal with those challenges, and move forward.

- **Mr. Tudor Constantinescu**, Principal Advisor, DG Energy, European Commission, provided his opinion on the 'import of hydrogen for EU and export from India'. He mentioned that if we want to decarbonize all heavy-duty transport and industrial sectors (steel, refineries), EU may in addition to its own production also require import. Additionally, hydrogen will play a critical role in achieving the carbon neutrality target for the EU and cost-effective grid integration of renewables. However, such a system of import would require having a common approach, the same methodologies for calculations of GHG emission and the estimation of the carbon footprint of various fuels, be it hydrogen or any other synthetic fuel. EU will look into the possibilities, including the transportation of hydrogen (as liquid or in the form of NH_3). First a level playing field is required in terms of the carbon footprint and in terms of guaranteeing renewable content in hydrogen or low carbon hydrogen.

1.7. Closing remarks

Mr. Matthieu Craye, International Relations Officer, DG Energy, European Commission, thanked the organisers, speakers and participants and welcomed all the concrete ideas shared in the webinar, including as regards pilot implementation, project costs, price economics, assured offtake, focusing on broader picture of policy support and harmonization of certification and standards. He stressed the importance of joining forces in several multilateral and bilateral initiatives and reminded everybody of the 'upcoming EU Hydrogen Week' in November, that resembles another good occasion to have further exchanges between EU and India stakeholders on hydrogen.